The Implementation of Prompted Retinal Screening for Diabetic Eye Disease by Accredited Optometrists in an Inner-city District of North London: a Quality of Care Study

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Diabetic retinopathy remains the most common cause of blindness in people of working age but the provision of high quality eye screening for diabetic patients is still erratic in many health districts in the UK. National consensus guidelines recommend comprehensive population coverage, high sensitivity (>80 %), high specificity (>95 %), agreed clinical criteria, referral procedures and centralized data collection to facilitate audit. This study looks at the effectiveness of implementing a prompted recall programme for retinal screening in an inner-city district of North London. The scheme uses trained, accredited optometrists to screen patients with diabetes who are looked after in the community by their general practitioner. During the first 17 months of the scheme, 63 optometrists attended training and gained accreditation. Of the 666 patients recruited, 645 were scheduled for screening and 536 (83 %) attended. Fourteen per cent of patients screened were found to have background retinopathy and 2.3 % sight-threatening eye disease. In two audits, carried out 15 months apart in a random sample of GP practices, the incidence of recorded dilated fundoscopy increased from 48 % at baseline to 56 %, an increase of 8 % (95 % CIs 2 %–14 %). For referable eye disease, the sensitivity of this screening technique was 100 %, the specificity 94 % (95 % CIs 90 %–98 %), the positive predictive value 79 % (95 % CIs 72 %–86 %) and the negative predictive value 100 %. The administrative cost per case screened was £12.60 (excluding clinical costs and any additional optometry payment). © **1998 John Wiley & Sons, Ltd.**

Diabet. Med. **15 (suppl. 3): S38–S43 (1998)**

Introduction

Diabetic retinopathy remains the most common cause of preventable blindness in people of working age,[1] despite clear evidence that blindness can be avoided by early treatment with laser photocoagulation.[2] Reducing the incidence of blindness is now an achievable aim, the St Vincent Group[3] declaring in 1989 that screening could reduce the incidence of new blindness by one third. Because sight-threatening diabetic retinopathy (STDR) can be asymptomatic and progression of the disease is unpredictable,[4] reduction in the incidence of new blindness depends upon regular, high quality retinal screening, with a wide population coverage. Calls have been made periodically for a nationwide, community-based retinal screening programme to be established[5,6] but no such national scheme has so far been set up. The haphazard nature of current arrangements has led to the suggestion that only litigation, with increasingly heavy penalties, is likely to achieve what is required.[7]

Studies evaluating different methods of retinal screening[8–11] have shown variable results. Methods examined include direct ophthalmoscopy, retinal photography or biomicroscopy (slit lamp examination) by different health care professionals. These studies generally indicate that the quality of screening depends on the skill and degree of training possessed by the screener and ease of access to the service. Although ophthalmologists are the best able to detect and assess retinopathy,[12] they are the least accessible and would be unable to manage the volume of work involved. General practitioners (GPs), on the other hand, while being more accessible, are less confident about their ability to screen for retinopathy.[13] Optometrists are both accessible and experienced in examining the eye.

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 CCC 0742–3071/98/S30S38–06$17.50

A variety of factors in inner-city practice conspire to make screening and follow-up of patients with chronic disease difficult.[14] In this inner-city district of north London over 40 % of GP practices are single-handed, some with list sizes of up to 3000 patients. While these factors contribute to the need for a centrally organized screening programme they also increase the organizational difficulties of setting up and maintaining such a scheme. Our study set out to evaluate the effectiveness of a computerized prompted recall scheme, run on customized software developed by the Whittington Hospital Clinical Audit Co-ordinator, which prompts patients to attend trained, accredited optometrists for retinal screening.

Methods

In March 1995 a retinal screening programme modelled on a successful pilot[15] was introduced to GP practices within the catchment area of the Whittington Hospital. The scheme was designed for patients with Type 1 or 2 diabetes mellitus, who received all their diabetic care from their GP and were therefore not regularly attending a hospital diabetic outpatient or eye clinic. Patients were recruited as a result of routine contacts with GPs, either during an organized diabetic clinic, or on an opportunistic basis. Patient details were recorded on a consent form at the practice, where the importance of regular eye examinations was explained. The date of their last eye examination was recorded. Patients received an information leaflet explaining how the scheme would work and gave informed, signed consent. The consent forms were sent by the practice staff, in pre-paid envelopes, to the central database, where the data were entered and the prompt activated.

Local optometrists located within easy reach of participating general practices were invited to attend a specialist training programme. Seventy-eight per cent of those invited attended. The training programme comprised lectures on diabetes and diabetic retinopathy with practical sessions involving the examination of patients with retinopathy. Teaching was carried out by both consultant ophthalmologists and consultant diabetologists. A protocol classifying the different types of diabetic retinopathy and lens defects was introduced, together with criteria for referral to an ophthalmologist (Table 1). Three training courses were held, each followed by a formal assessment which optometrists were required to complete satisfactorily; those optometrists who failed the assessment (5 %) repeated the course and the accreditation. In addition to the usual sight test fee, Camden & Islington Health Authority agreed to pay an additional £20 for each fundoscopic examination carried out by the scheme within its jurisdiction, this payment coming into effect 18 months after the launch of the scheme.

Patients were sent their first prompt 12 months after a previous eye examination, each patient receiving a personalized eye record which they took to one of the participating optometrists. Results of eye checks were returned to a central database at the Whittington Hospital and to the patients' GPs. Reminder letters were sent after 3 weeks and if patients failed to attend after 6 weeks their GP was informed. Those patients who failed to respond were prompted again 12 months later. Referrals to an ophthalmologist can be made directly by optometrists and are organized by the prompting system.

Referral Criteria

Optometrists grade fundoscopy findings into normal, background only, maculopathy, pre-proliferative, proliferative, and advanced retinal disease, as set out in the protocol based on the Airlie House Grading System (Table 1). Cataracts are classified as early (intervention not required) or advanced (intervention likely to be needed). 'Referral early' (patient to be seen within 10 weeks) is advised if maculopathy or preproliferative retinopathy is seen and 'referral urgent' (patient to be seen within 2 weeks) if proliferative or advanced eye disease is present. Patients are referred to ophthalmic outpatients routinely (patient to be seen within 14 weeks) for cataracts, and if optometrists are uncertain of a diagnosis.

Analysis of Patient Referral Between 1 March 1995 and 30 June 1996

For the purposes of analysis, the 'worse' eye was used to classify patient retinal status. When sight-threatening diabetic retinopathy (STDR) and cataracts coexisted, the patient was coded as having STDR. Where the optometrist had no view of the retina because of cataract, the coding was cataract.

General Practice Audit of Retinal Screening

To measure any change in the proportion of patients screened, an audit was designed to take place in a random sample of 16 local general practices, stratified into two groups, those providing structured diabetic care (Group 1, 10 practices), and those that did not (Group 2, 6 practices). Prior to the launch of the screening programme, the baseline audit of eye care employed the random selection of 35 patient records (or all records if there were fewer than 35 diabetic patients registered) from each practice diabetic register (mean 32, range 22–35, total 509, patient records). The proportion of patients with any record of dilated fundoscopy within the previous 15 months was recorded. After prompted screening had been in place for 15 months, the same sampling technique was used to re-audit eye care (mean 31, range 21–35, total 490, patient records). The sample size was calculated on the assumption that 30 % of patients would have been screened at baseline and we wished to detect

Table 1. Optometrist screening protocol: follow-up and referral criteria

1.	*No diabetic retinopathy*	Optometrist review in 1 year
2.	*Background retinopathy*	Optometrist review in 1 year
a.	(Mild non-proliferative) = occasional haemorrhages and/or microaneurysms and exudates not within 1 disc diameters of fovea, few cotton-wool spots	(see point 2 below)
b.	Patients with Type 1 diabetes who have not had retinopathy diagnosed before, and have recent onset of background retinopathy	Refer to ophthalmologist for *routine* assessment
c.	*Non-proliferative retinopathy* with large circinate or plaque exudate within the temporal arcade but not within 1 disc diameter of macula	Refer to ophthalmologist *routinely*
3.	*Maculopathy* (non-proliferative with macular involvement) = exudate and/or haemorrhages within 1 disc diameters of fovea. Macula oedema seen or presumed as reduced corrected visual acuity	Refer to ophthalmologist *early*
4.	*Pre-proliferative retinopathy* (severe background) –venous irregularities –multiple cotton wool spots –multiple deep blot haemorrhages –intraretinal microangiopathy (IRMA)	Refer to ophthalmologist *early*
5.	*Proliferative retinopathy* –new vessels on the optic disc or elsewhere on retina –preretinal haemorrhages –preretinal fibrous tissue	Refer to ophthalmologist *urgently*
6.	*Advanced diabetic eye disease* –vitreous haemorrhage –extensive preretinal fibrous tissue –recent onset retinal detachment –rubeosis	Refer to ophthalmologist *urgently*
	Other findings	
	No view of fundus	Refer to ophthalmologist *routinely*
	Cataract	Refer to ophthalmologist as usual practice
	Raised intraocular pressure	Refer to ophthalmologist as usual practice
	Macular degeneration and other non-diabetic retinal findings	Refer to ophthalmologist as usual practice

a 10 % increase with 90 % power at a 5 % level of significance.

Sensitivity, Specificity and Positive Predictive Value of the Screening Technique

To determine the rate of false positive referrals, the hospital records of all patients referred for an ophthalmic opinion during a 6-month period (1 January to 30 June 1996) were reviewed against the agreed protocol. To detect false negative cases, all patients screened negative during this period were invited to be rescreened within 12 weeks of their initial optometric review, by a consultant or registrar ophthalmologist using slit lamp examination.

Observer Variation: Kappa Statistic

A group of 90 patients, half of whom were drawn from the screened negative group and half of whom came from the hospital diabetic eye clinic, were examined by both the consultant and her registrar to assess observer variation using the kappa statistic.

Results

Take-up in All Practices

Of 75 eligible general practices approached, 58 (77 %) agreed to participate. Ten refused because they had their own recall system in operation, 2 practices already sent all their patients to hospital out-patients, and 5 did not respond. Out of the 58 practices who agreed to participate, only 43 practices actively recruited patients to the scheme during the study period. A total of 666 patients were recruited to the scheme during this period, an estimated 30 % of all eligible patients. Of those recruited, 645 were scheduled for eye review during the study period, 536 (83 %) attended. Of the 536, 78 (12 %) were referred to an ophthalmologist.

General Practice Audit of Dilated Fundoscopy

Dilated fundoscopy in the previous 15 months was recorded for 244 (48 %) of the 509 diabetic patients sampled during the baseline audit. Re-audit of randomly

selected patients in the same practices after 15 months showed that 274/490 (56 %) had a record of dilated fundoscopy, an increase of 8 % (CIs 2 %–14 %, χ^2 = 5.7, p = 0.02). Percentage change across individual practices ranged from –10 % to +52 %. Practices in Group 1 (providing structured diabetes care) had increased by a mean of 11 % (CIs 3 %–19 %, p = <0.01), while Group 2 practices (no structured care) had made no significant improvement.

Quality audit: Sensitivity, Specificity, and Positive Predictive Value of the Screening Technique

During the period 1 January 1996 to 30 June 1996, 191 patients were reviewed by participating optometrists. Patients screened negative in this group (n = 163) were invited to attend for rescreening by the consultant ophthalmologist or her registrar. Eighty-eight patients attended (53 %). There were no differences between attenders and non-attenders in age, gender, time since diagnosis or place of residence. Rescreening showed no false negatives according to the referral criteria as outlined in the protocol.

Of the 28 patients referred to ophthalmology outpatients during the same period 22 (79 %) were assessed as appropriate referrals and 6 (21 %) as inappropriate. These results show that for referable eye disease, optometric screening produced a sensitivity of 100 %, a specificity of 94 % (CIs 90 %–98 %), a positive predictive value of 79 % (CIs 72 %–86 %) and a negative predictive value of 100 %.

Observer Variation

Examination of 90 patients to control for observer variation by the same 2 ophthalmic observers showed complete agreement for both optometric referral criteria and for the diagnosis of sight-threatening eye disease, kappa = 1.00, p = <0.001 in both cases.

Analysis of Patient Referral Between 1 March 1995 and 30 June 1996

Of a total of 536 patients screened during the entire study period, 78 were referred to an ophthalmologist (14.5 %). Three of these patients were referred to other hospitals and a further 8 defaulted leaving 525 for analysis.

Clinical Findings

Twelve (2.3 %) were diagnosed with STDR, 18 (3.4 %) with cataracts, of which 15 were listed for surgery and 6 (1 %) with glaucoma. A breakdown of reasons for referral is set out in Table 2. 72 patients (14 %) were found to have background retinopathy but did not need referral. Of the remaining 67 referred there were no 'urgent referrals'. Of those 'referred early' 95 % were seen within 10 weeks (range 2–13 weeks) and of those 'referred routinely' 92 % were seen within 14 weeks (range 4–22 weeks).

Costings

The costs involved in providing this prompted retinal screening have been divided into the set-up costs and recurrent annual costs of running the scheme thereafter. The set-up costs comprised: staff salaries for 1 year to recruit GPs and optometrists and to run initial training courses; software and programming costs; purchase of computer and peripherals; additional optometry training expenses, totalling £31 500.

Annual running costs (Table 3) are calculated on the basis of a projected future throughput of 2000 patients per year and include salary costs to administer the scheme. Stationery and postage cost 70 p per patient and with the addition of annual quality audit and annual optometry training, the costs total £25 250 or £12.62 per patient prompt. Additional possible costs may be incurred as a result of locally negotiated special fees for optometrists who provide this service. In our area, participating optometrists practising in Camden and Islington now receive a fee of £20, but because this cost is variable, and there is currently no nationally agreed fee for this work, it is sensible to quote the cost per patient screened as £12.62 excluding any additional payment to optometrists. Based on 2.3 % of patients presenting with STDR in our study, the cost per patient identified was £581.

Discussion

Consensus guidelines issued jointly by the Royal Colleges of Physicians, Ophthalmologists and General Practitioners, the College of Optometrists, and the British Diabetic Association,[16] characterize the standards to be met by a high quality retinal screening programme. Regardless of the method used, these should include comprehensive population coverage, high sensitivity (>80 %) and specificity (>95 %), low technical failure rate (<5 %), agreed referral processes and criteria, capacity to record visual impairment and blindness, and a locally agreed system of audit. In addition, such a system requires to be acceptable to patients and affordable to the health service.[6]

The scheme described here largely fulfils the criteria outlined above and has been set up on a service basis as the result of a multidisciplinary collaboration. In just over 2½ years of operation it has recruited 1500 patients, some 65 % of the eligible diabetic population resident locally. Based upon the current recruitment rate of around 70 new patients a month this figure should reach over 80 % after 3 years. Although this is considerably slower than the recruitment rate achieved in Poole,[17] where over 50 % of eligible patients were recruited within a 6-month period, this is undoubtedly attributable to local conditions where the problems and demands

Table 2. Diagnosis of patient referrals to the ophthalmologist during 17-month study period (1 March 1995 to 30 June 1996)

Diagnosis	Number of patients (subtotals)	Clinic visit outcome
Sight-threatening diabetic retinopathy	12	
Maculopathy	(9)	Treated with laser Follow-up in clinic
Pre-proliferative	(3)	Follow-up in clinic
Proliferative	(0)	
Cataract	18	
Visual acuity <6/18	(13)	Waiting list for surgery
Visual acuity >6/18	(5)	Discharged back to community screening
Glaucoma	6 (2 previous clinic attenders lost to follow-up)	Treatment started
Age-related macular disease	7	Discharged back to community screening
Other referable eye disease including: HIV related retinopathy Corneal scar Myopic retinopathy Shallow anterior chambers (optometrist unwilling to dilate) Pterygium	9	
Inappropriate referrals included: Referred as STDR – no retinopathy found Background retinopathy Drusen	15	Discharged back to community screening
Total number of patients	67	

Table 3. A breakdown of set-up costs and annual running costs for an estimated 2000 patients

Set-up costs (year 1)		Annual running costs based on an estimated 2000 patients	
Salaries plus 12 % oncosts Project co-ordinator (0.6 WTE nursing grade H) Project assistant (0.5 WTE A&C grade 3)	£20 500 (includes rent and other overheads)	Salaries (as set-up year)	£20 500
Software and programming costs	£7 000		
Computers and peripherals	£2 400		
Training costs	£1 600	Training courses (1 initial, 1 refresher)	£1 600
		Stationery and postage	£1 400
		Quality audit costs	£1 750
Total cost	£31 500		£25 250 £12.60 per patient

Additional fees C&I only = 1333 patients (2/3 2000) @ 83 % compliance rate = £22 133.00, or £20.00 per patient reviewed.

experienced by inner-city practitioners mean they are unable to prioritize every new initiative.[14] Fifteen practices who agreed to participate failed to recruit patients during the study period. The challenge, undoubtedly, is to find ways of supporting involvement by these practices, in order to improve population coverage.

The high compliance rate of 83 % by patients in this environment is a clear indication of the acceptability of the programme to patients and compares favourably with the 77 % compliance rate reported by a hospital-based optometry scheme in Liverpool.[18] In the Whittington scheme, patients can make appointments with optometrists at a time to suit themselves, including Saturdays, and do not have far to travel. Maintaining high compliance with large numbers will depend upon ensuring that the register of patients who require prompting is kept up to date. Continual updating of patient records within the scheme provides an excellent data source for maintaining our local district register.[19]

Training and assessment courses leading to optometric

accreditation have been oversubscribed and the protocol well received. We attribute the very high sensitivity (100 %) and specificity (94 %) of optometric screening, similar to that achieved by trained, hospital-based optometrists using slit lamps[18] (sensitivity 91 %, specificity 94.5 %), to the training which optometrists received, the protocol adopted, and the characteristic we chose to study, namely, referable eye disease as defined by the protocol, rather than simply the presence or absence of diabetic retinopathy.

A further measure of the impact of the scheme upon the resident diabetic population is provided by the general practice audit 15 months into the scheme. This found a modest but statistically significant rise in the take-up of dilated fundoscopy of some 8 %. The audit was undertaken in a randomly selected group of practices in which recruitment to the prompting scheme was variable. We estimate that the true rise may have been greater, since 42 % of patients in our audit sample were hospital diabetic outpatient attenders and therefore not eligible for the scheme. The prevalence of STDR found after the 17-month study period of 2.3 % is considerably lower than that found by Harding *et al.*[20] in Liverpool where diabetic clinic and eye clinic attenders were included and half that found by O'Hare *et al.*[8] in southwest England. However, our screening revealed other types of diabetes-related eye disease, notably advanced cataract requiring surgery, chronic open angle glaucoma, and age-related maculopathy (Table 2).

The Association of Optometrists would like screening for diabetic retinopathy to be seen as a service distinct from the general ophthalmic service, allowing patients to choose to have assessments of refraction and retinopathy screening at different times and sites.[21] There is, as yet, no nationally agreed fee for retinopathy screening and the special supplement of £20 per assessment paid by Camden and Islington may not be followed by other districts. The cost of £12.60 per patient prompted provides health authorities with an estimate of baseline running costs, before entering into negotiations with local optical committees for special remuneration for this work.

The model of primary-care-based screening described here, which combines computerized prompted recall for patients with screening by trained, accredited optometrists, can provide an effective service with high sensitivity and specificity to an inner-city diabetic population.

Acknowledgements

This project was supported by a grant from North Thames Regional Health Authority, Department of Quality and Audit. We would like to thank the Whittington Hospital Trust for their continuing support for our work and especially M. Rogers, Clinical Audit Co-ordinator at the Whittington Hospital Trust, for the software design and development of the computer prompting system.

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